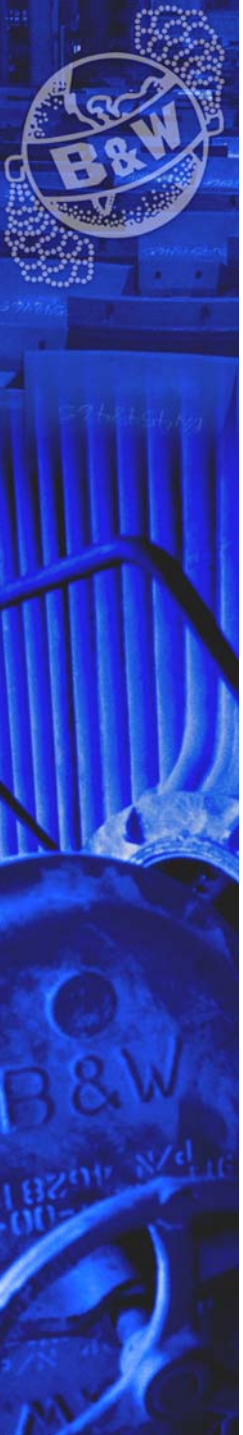


B&W's Reburning Experience

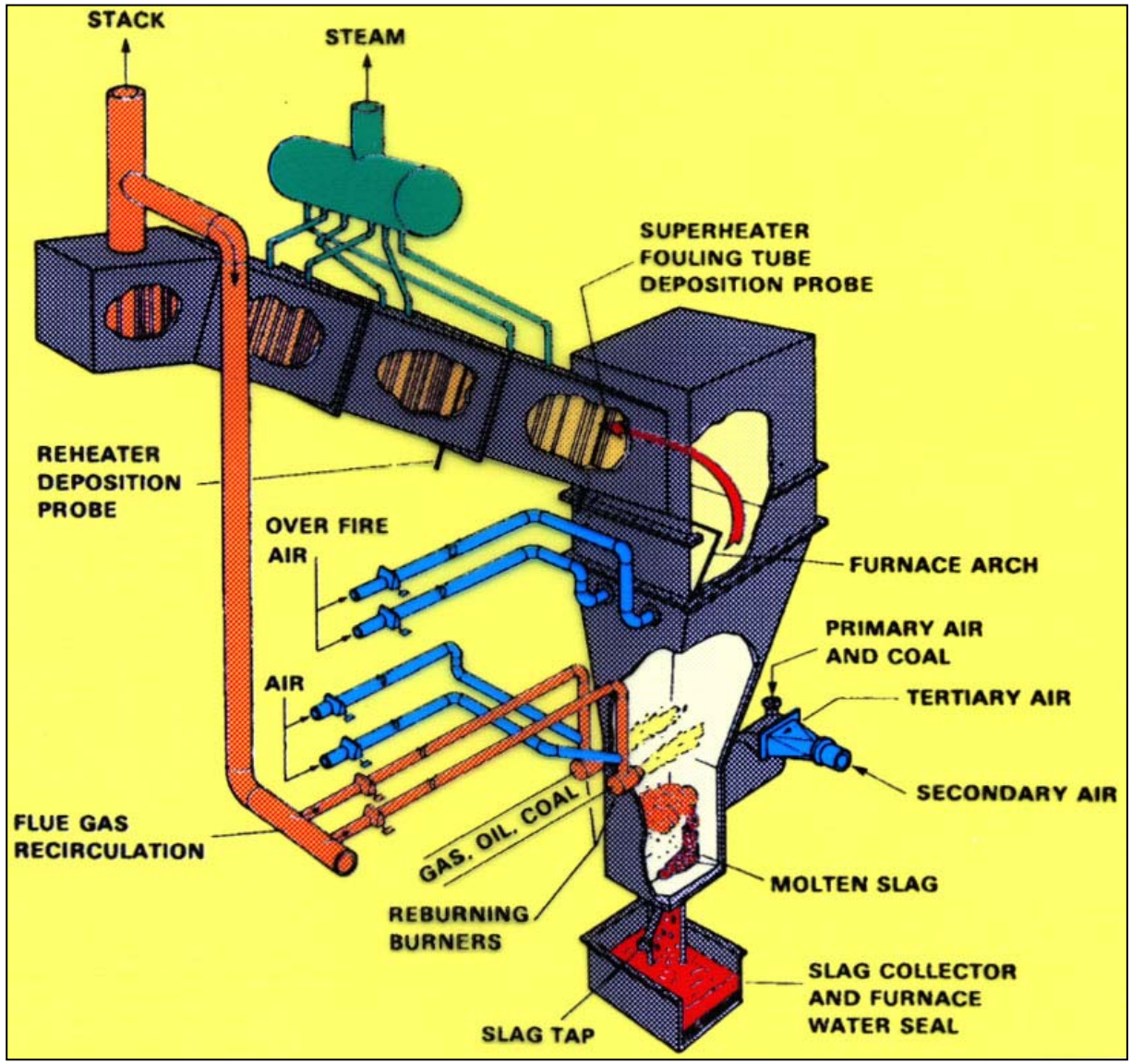
2004 Conference on Reburning for NOx Control
USDOE NETL

H. Farzan, G. Maringo, A. Yagiela, A. Kokkinos
Babcock & Wilcox, Co.

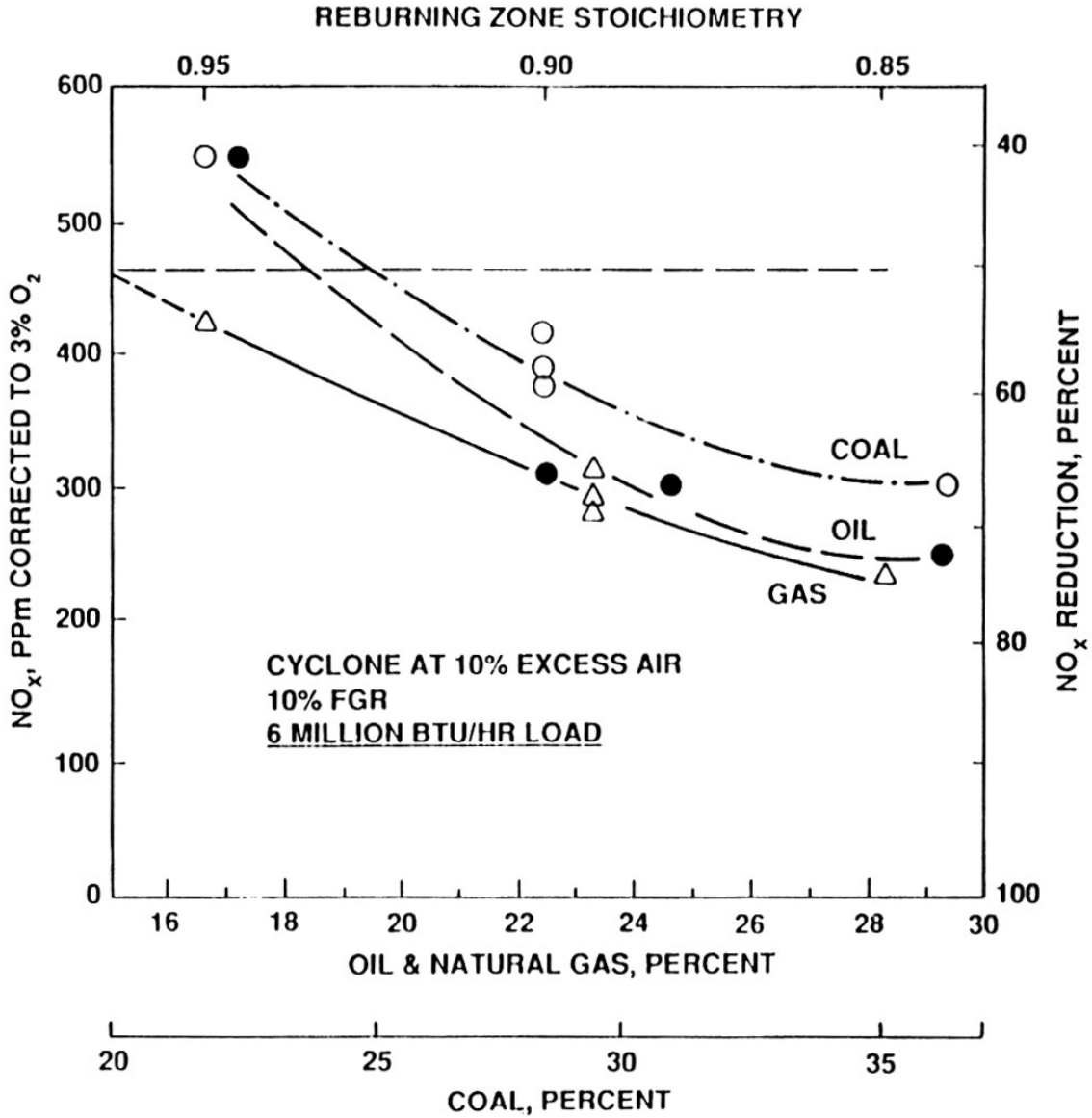
B&W's Reburning Experience

- 1985 EPRI Sponsored Engineering Study to Prove Feasibility
- Extensive Pilot Scale Testing at B&W's Research Facility in Alliance, Ohio
  - Coal (bituminous, sub-bituminous, and lignite), Gas, Oil, and Coal-Water Slurry Reburn Fuels
- Full Scale Demonstration/Commercial Applications
  - 110MW Cyclone-Equipped Boiler Coal Reburn Project at Alliant's Nelson Dewey Station. DOE Clean Coal Demonstration firing bituminous and sub-bituminous coals.
  - 600,000 #/hr steam flow boiler using Gas Reburn at Eastman Kodak Park. Commercial application, operating since 1995.
  - Two (2) 440,000 #/hr steam flow boilers using Gas Reburn at Eastman Kodak Park. Commercial application, operating since 1998.
  - Three (3) 350 MW Oil/Orimulsion wall-fired boilers at New Brunswick Power's Coleson Cove Station. Presently under start-up operations on 1st unit.

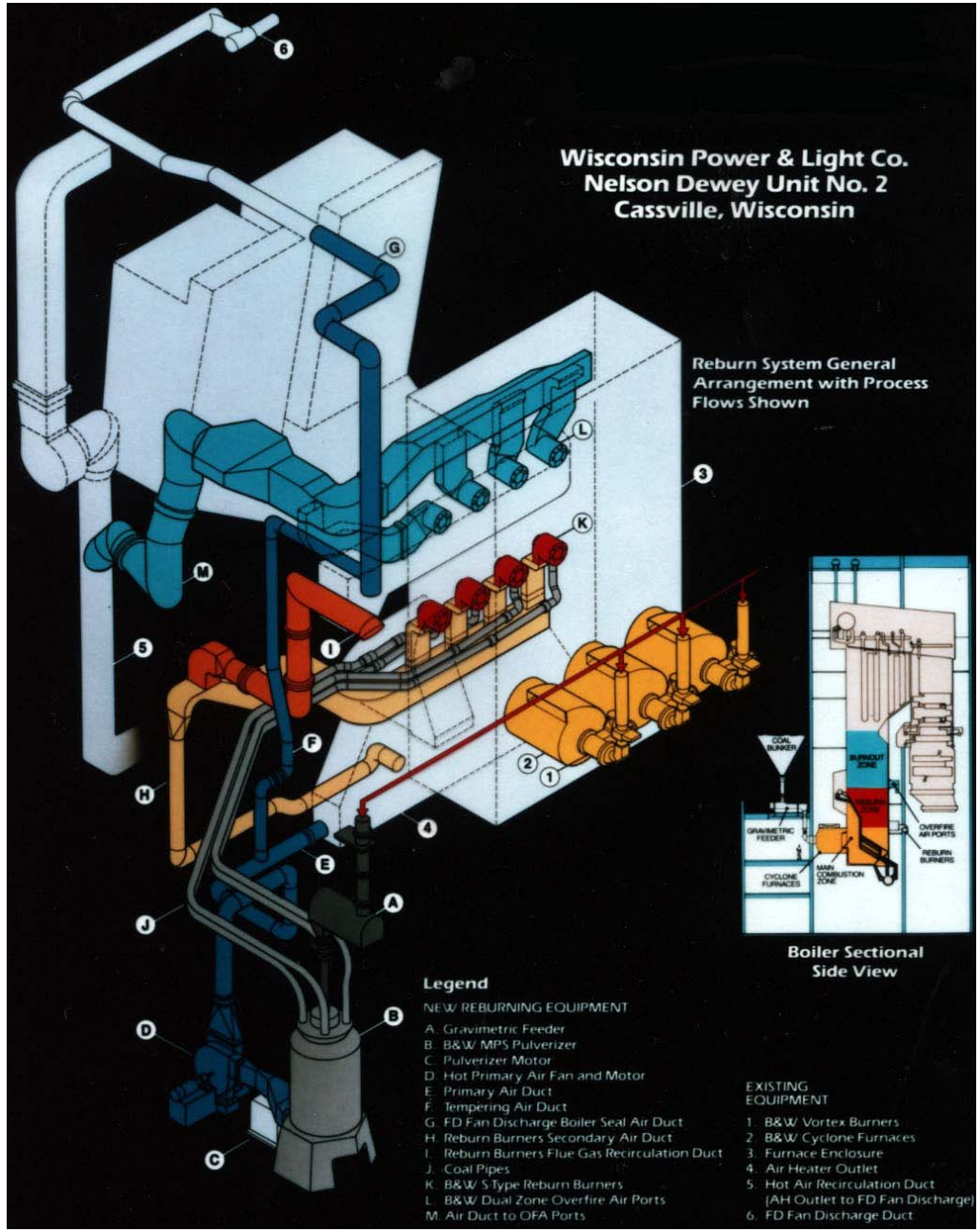
B&W's Small Boiler Simulator (SBS)



NO_x Levels with Reburning

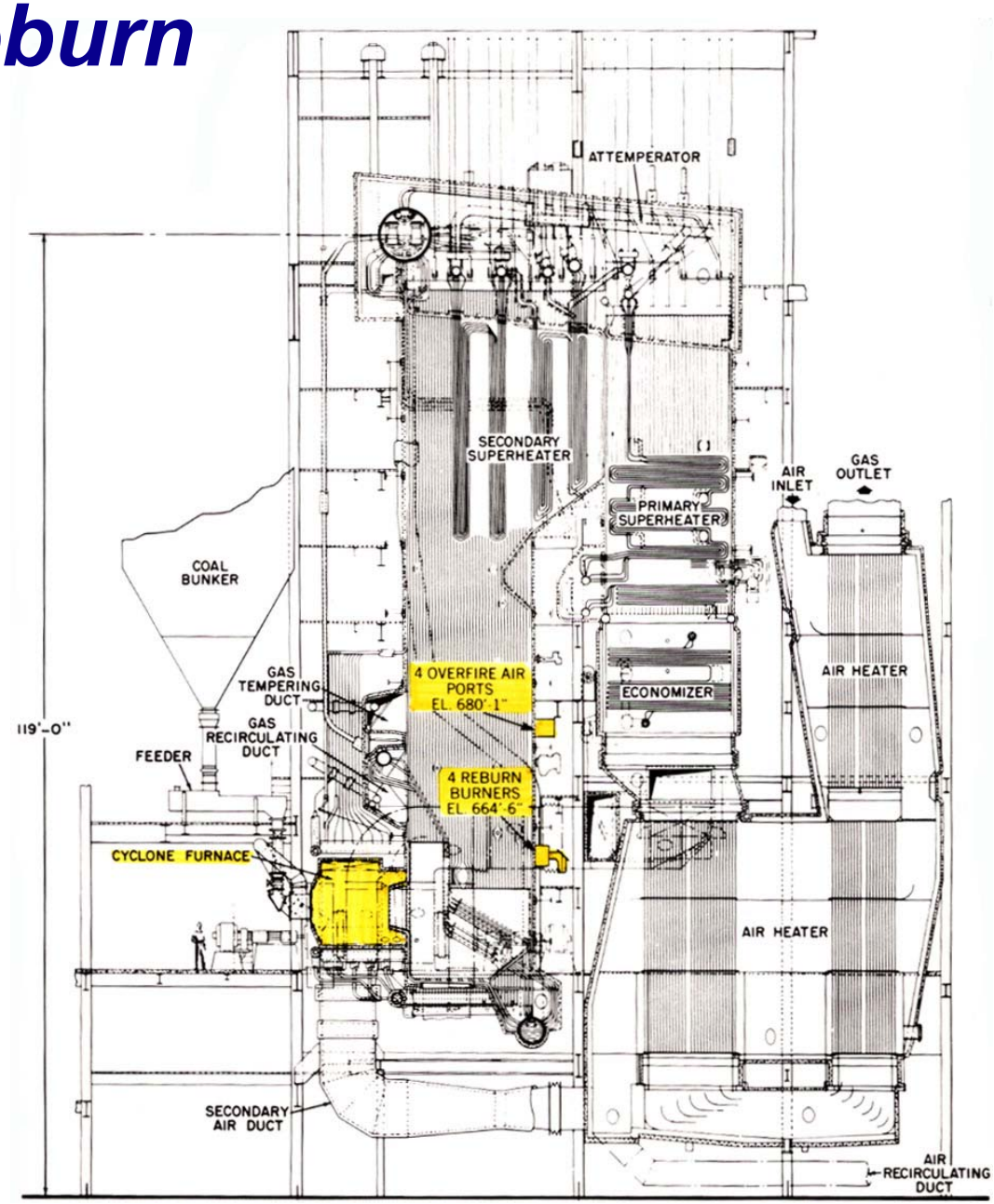


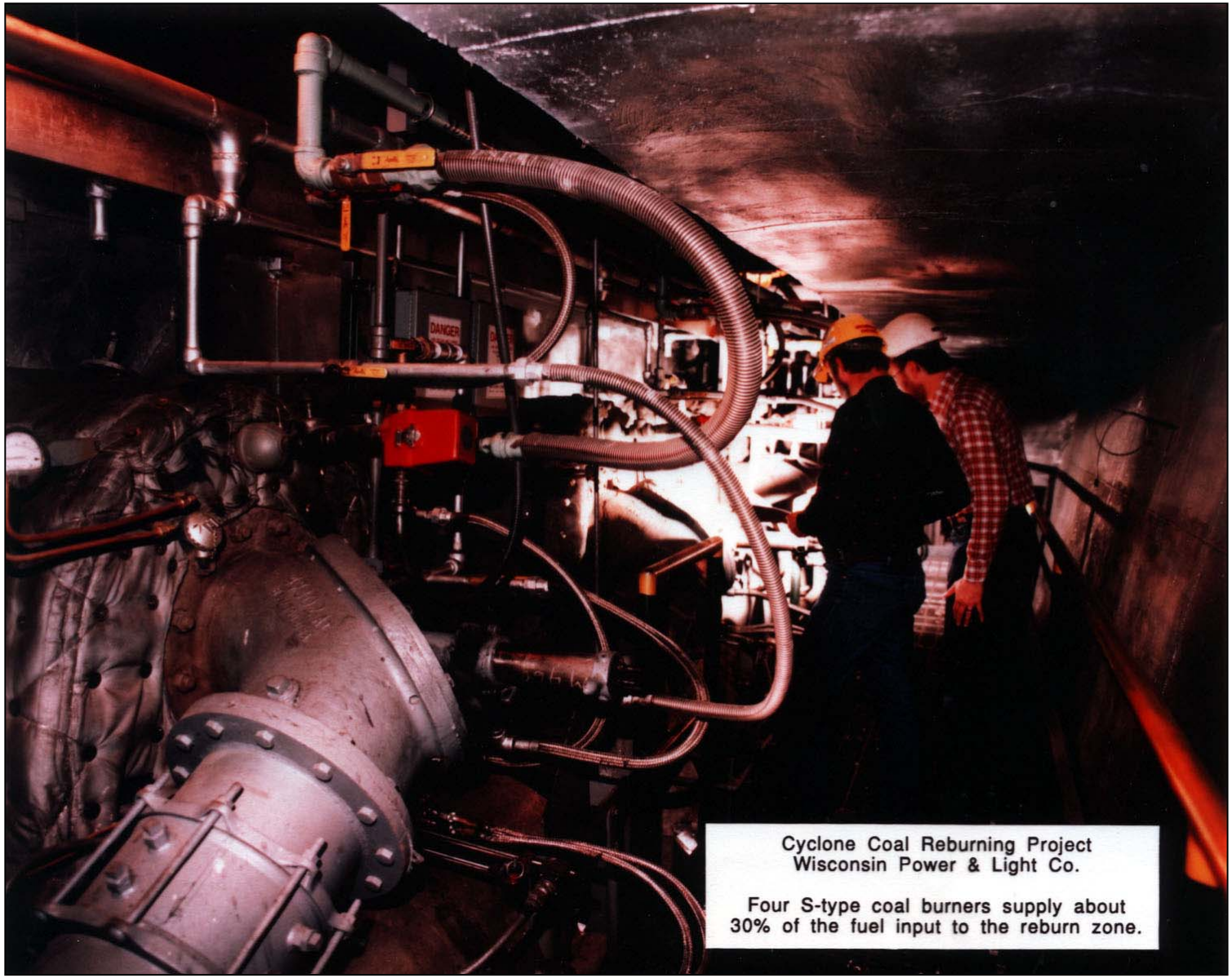
Coal Reburning for Cyclone NO_x Control



Cyclone Reburn Project

Wisconsin Power & Light
Nelson Dewey Unit 2 (RB-369)



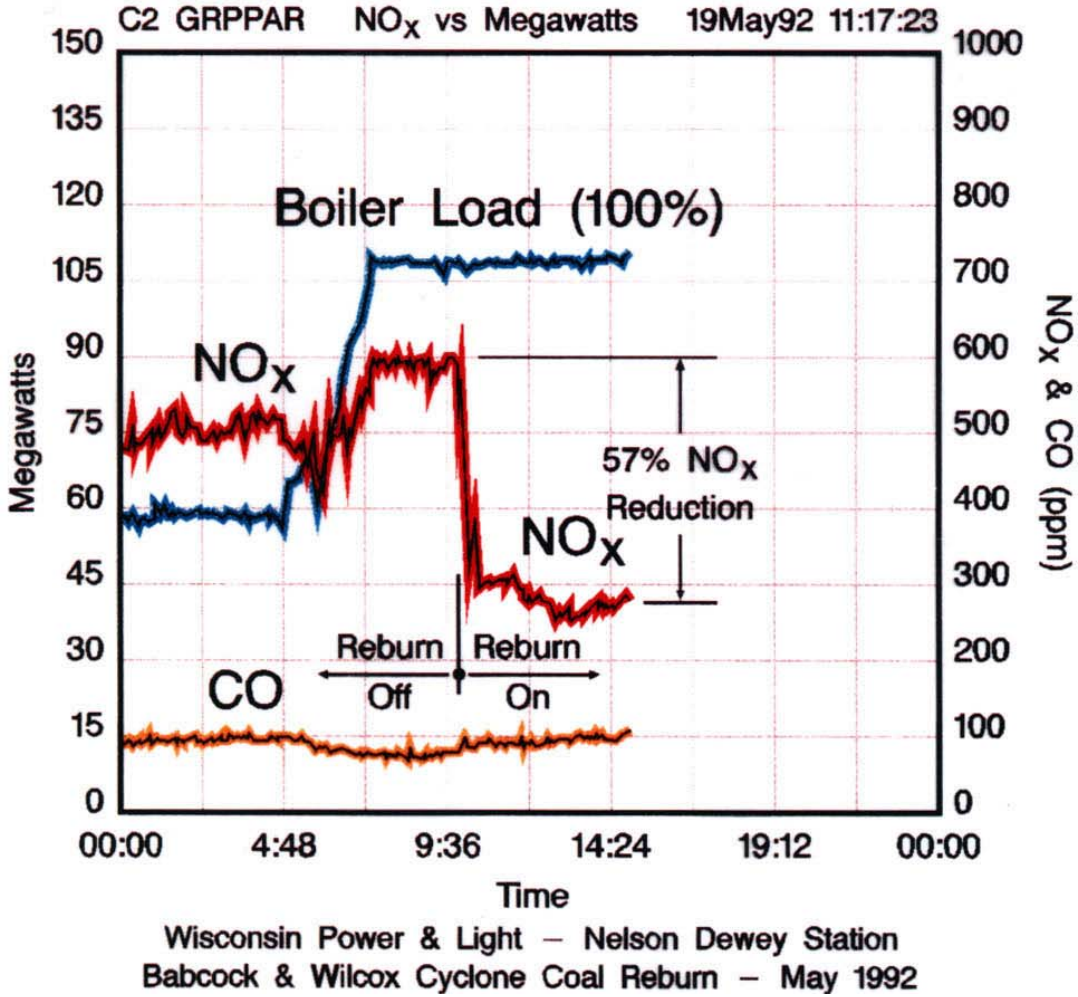


Cyclone Coal Reburning Project
Wisconsin Power & Light Co.

Four S-type coal burners supply about
30% of the fuel input to the reburn zone.

Nelson Dewey Unit 2 - Results

- Baseline Data
  - NO_X: 0.83 lb/10^6 Btu
  - UBC: 9 – 18%
- Results
  - NO_X: 0.38 lb/10^6 Btu
  - UBC: 13 – 22%
  - Decreased FEGT
  - Reduced spray flows
  - Increased output by 10 MWs



Boiler Performance and Reburn Side Effects Review

Furnace Exit Gas Temperature

- Bituminous Coal Reburn = ~150-200 F Lower
- Sub-bituminous Coal Reburn = ~25-50 F Lower
- Gas Reburn = No Change

Attemperator Spray Flows

- Bituminous Coal Reburn = ~75% Lower
- Sub-bituminous Coal Reburn = ~25% Lower
- Gas Reburn = No Change

Boiler Performance and Reburn Side Effects Review

Header/Tube Metal Temperatures

- Reburning = No increase from Baseline

Slagging/Fouling/Opacity/Precipitator Performance

- Reburning = No Change

Furnace Corrosion

- Reburning = No Change (minimal data)

Boiler Load Limitations

- Reburning = No Detrimental Change (Potential to Increase)

Boiler Performance and Reburn Side Effects Review

Furnace Exit Gas Temperature
- Bituminous Coal Reburn = ~150-200 F Lower
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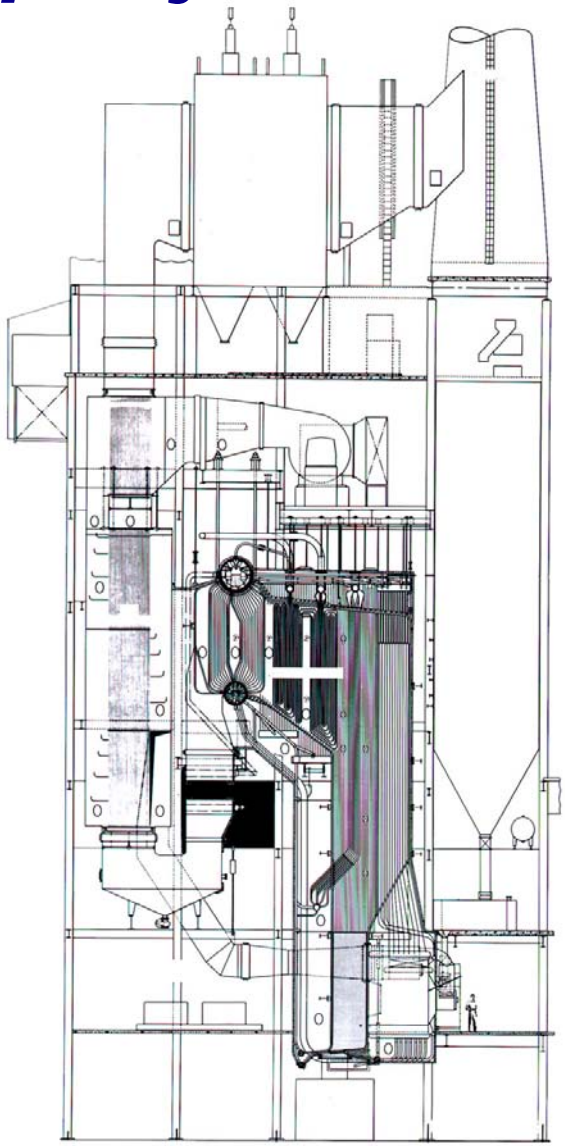
Furnace Corrosion
- Reburning = No Change (minimal data)

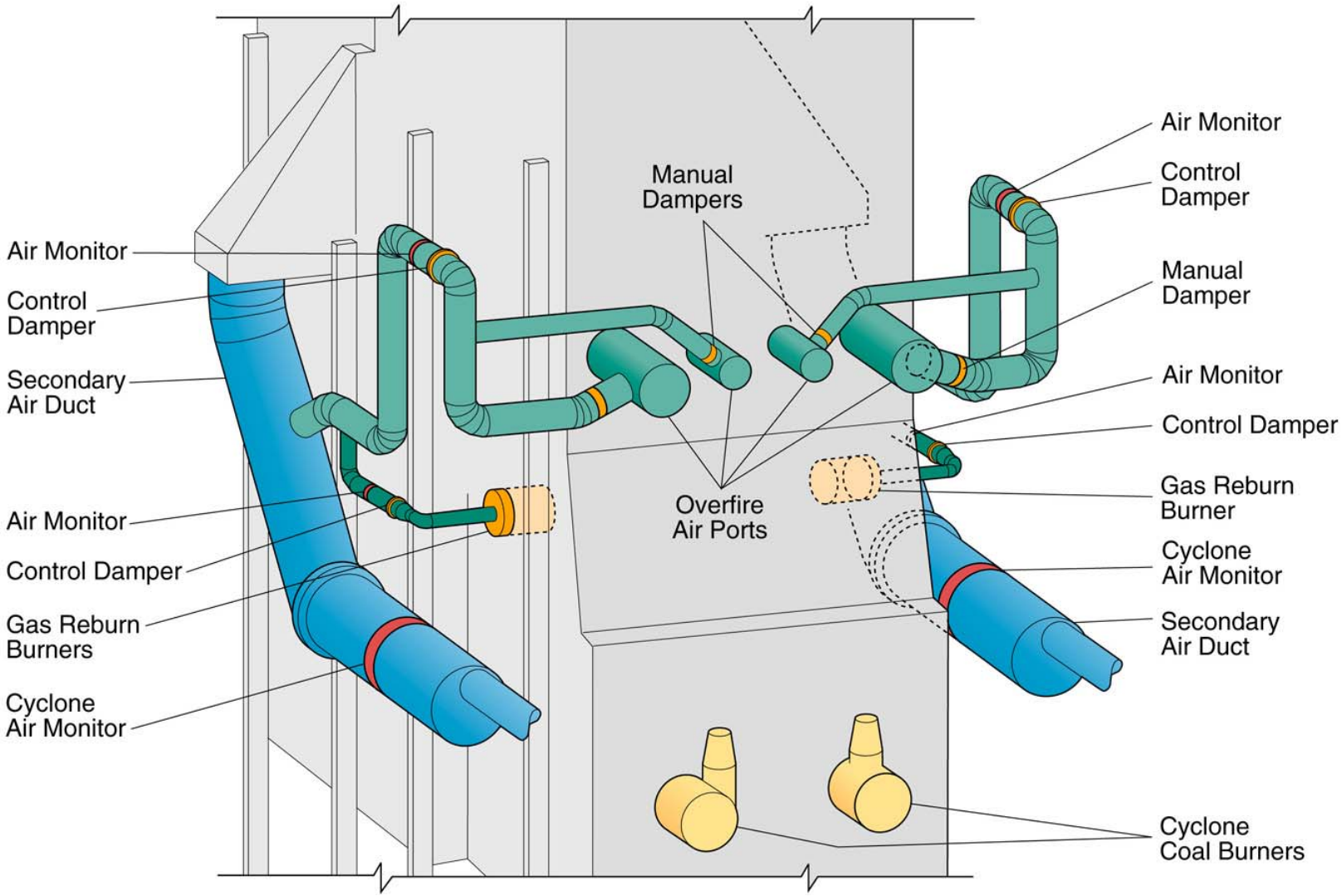
Boiler Load Limitations
- Reburning = No Detrimental Change (Potential to Increase)

Eastman Kodak Company

- Kodak Park, Rochester N. Y.
  Units 41 & 42
- 400,000 lbs/hr steam flow
- Two 8’ diameter cyclones per unit
- Baseline NO_X: 1.2 lbs/10^6 Btu

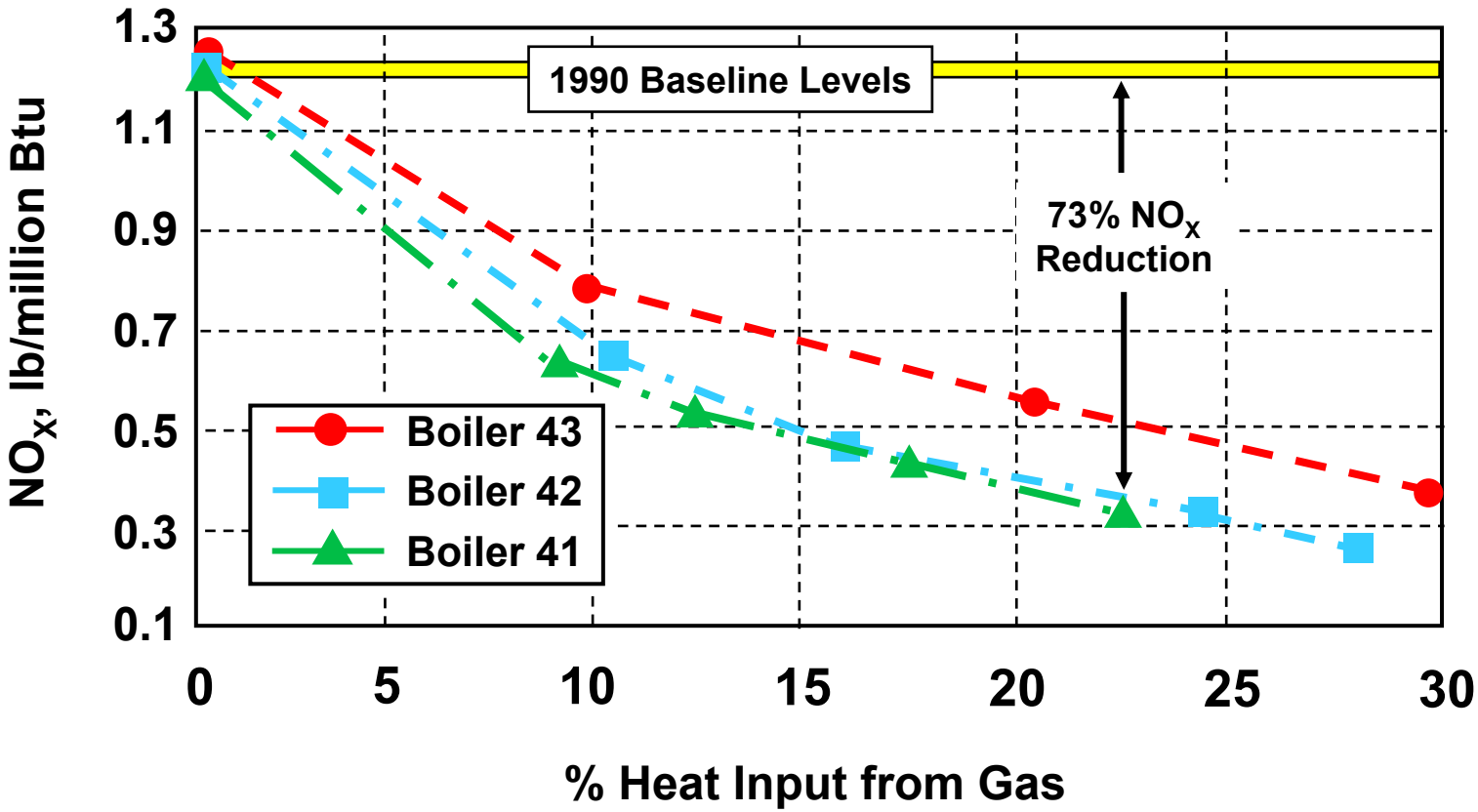


B&W Gas Reburn and Overfire Air System



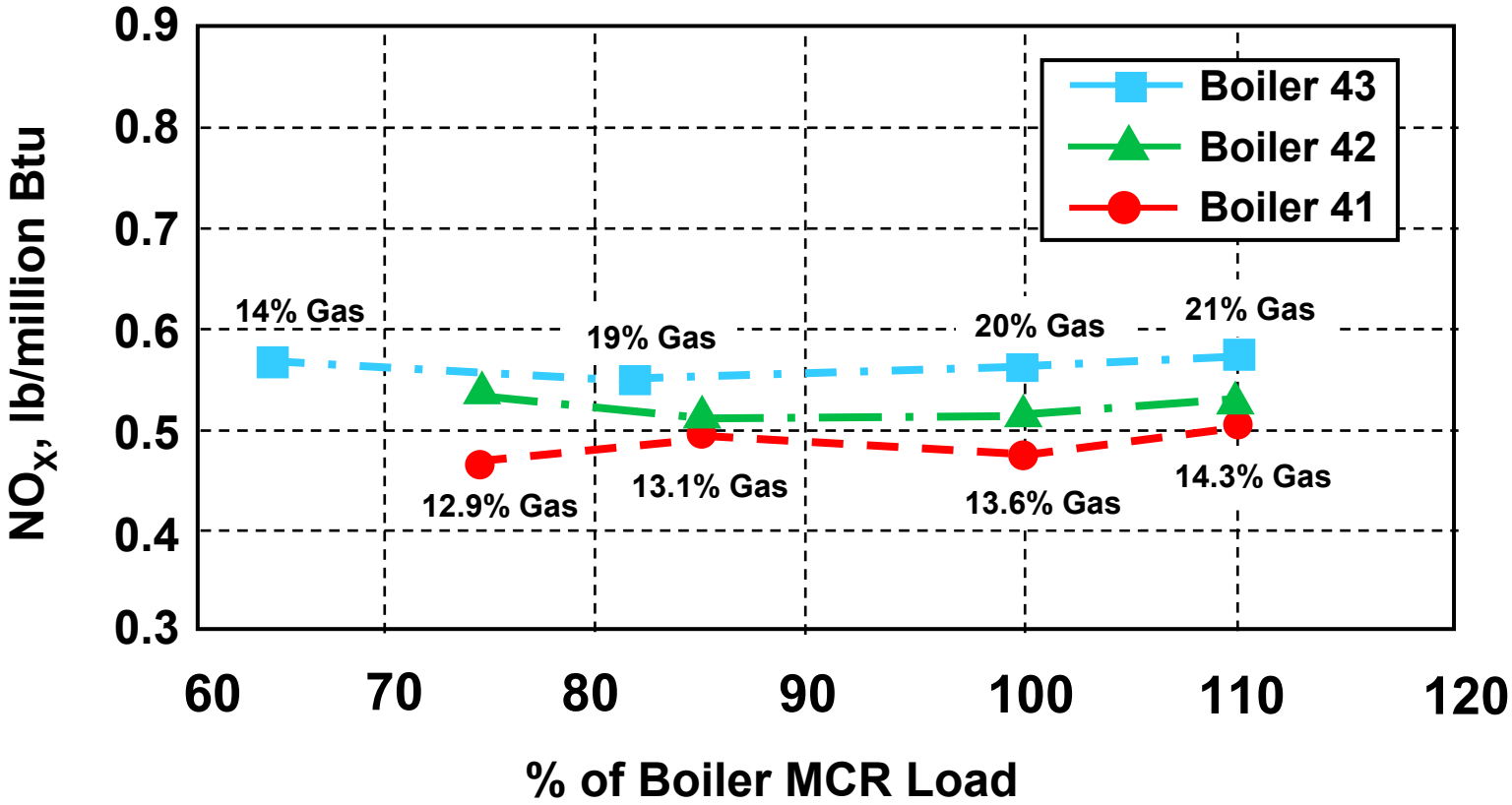
Kodak Park Gas Reburning NO_X Emission Summary

% Gas Heat Input vs NO_X Emission Levels
MCR Load Conditions



Kodak Park Gas Reburning NO_X Emission Summary

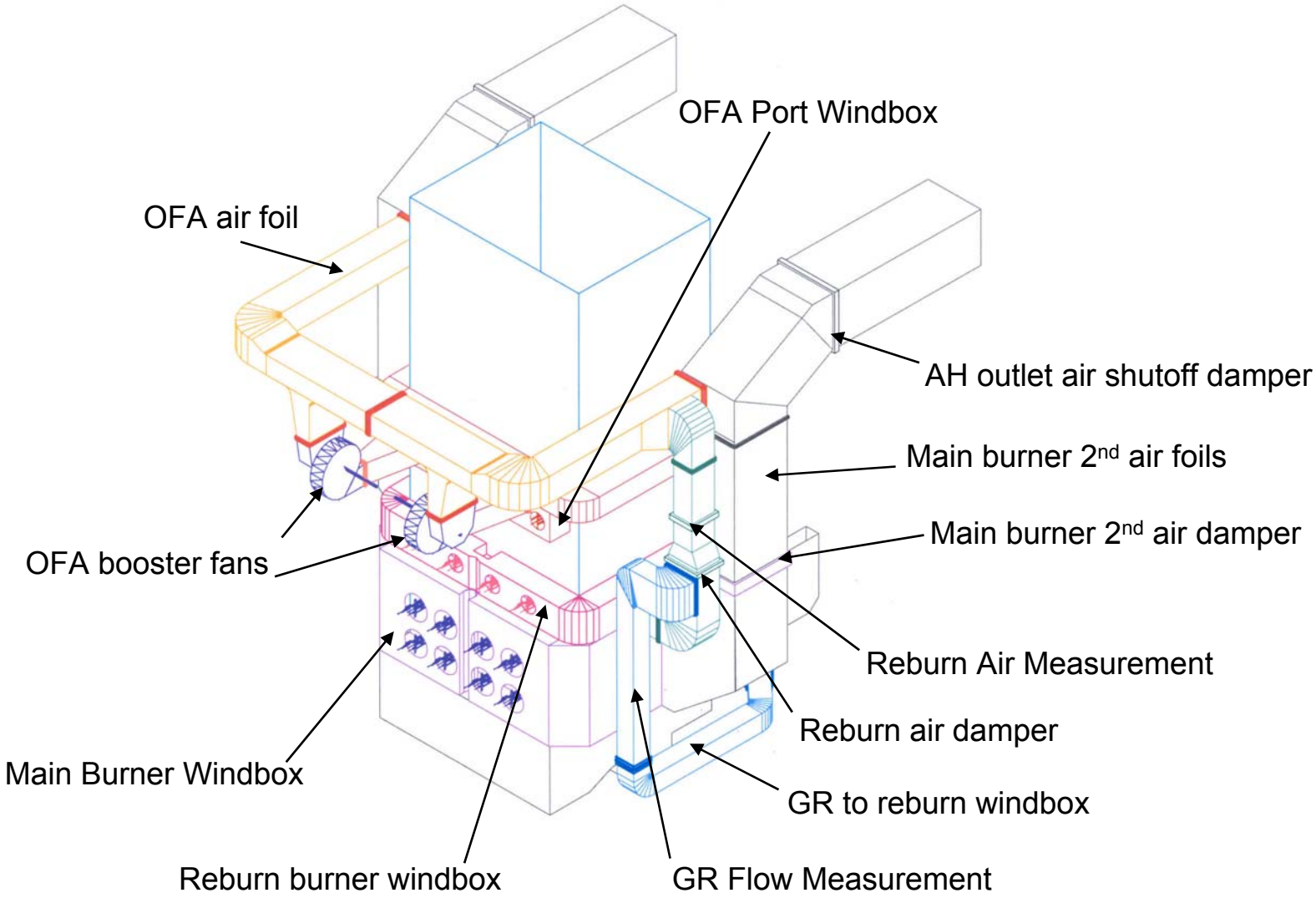
% Boiler Load vs NO_X Emission Levels
Optimized Control Conditions



Coleson Cove: General Scope of Supply for the Combustion System

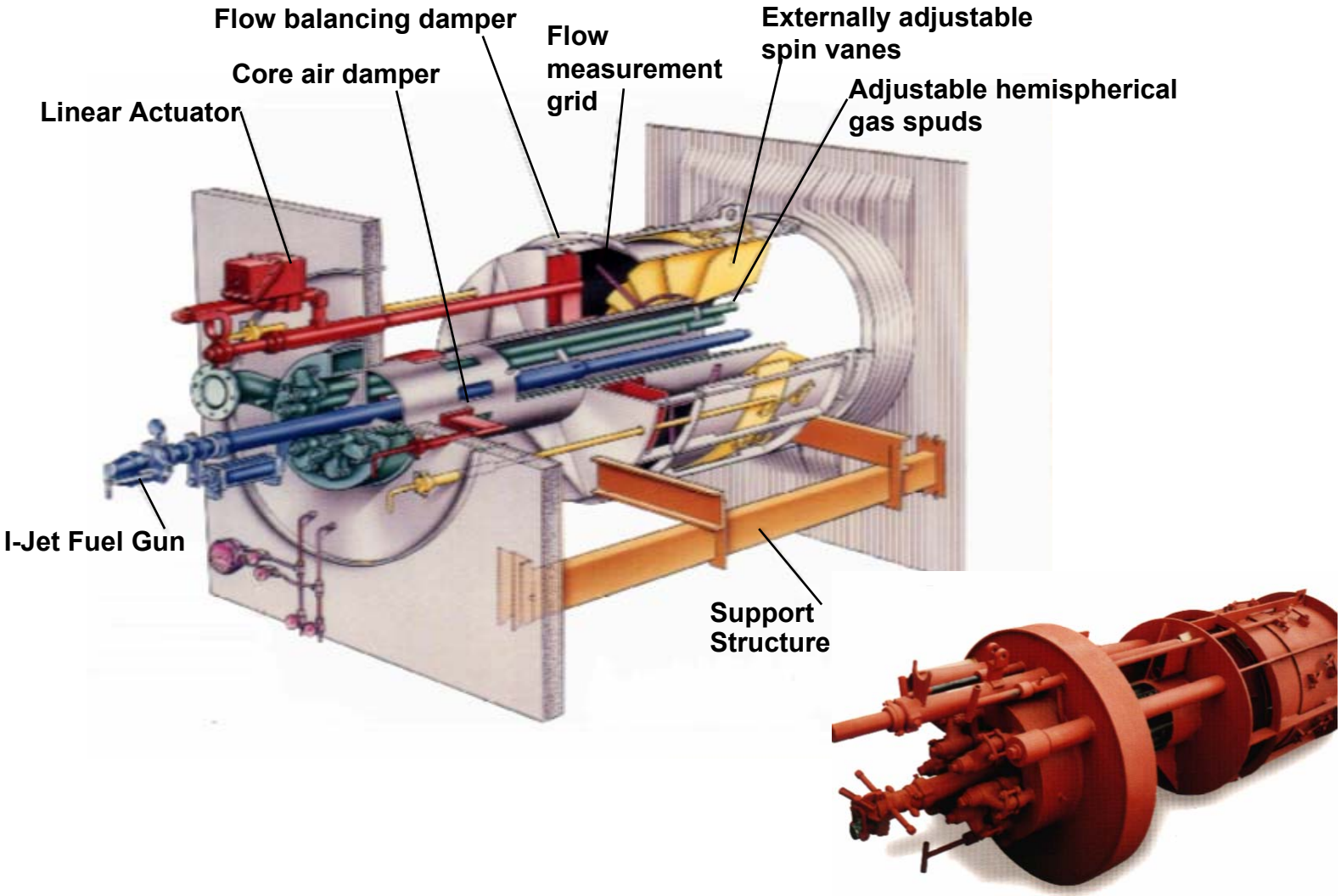
1. (16) New B&W XCL-S® oil/Orimulsion fired low NO_X burners (including ignitors and scanners)
2. (8) New B&W XCL-S® oil/Orimulsion fired reburn burners (including ignitors and scanners)
3. (9) New Dual Air Zone Overfire Air (OFA) Ports
4. New water-cooled tube openings (burners and ports)
5. (2) New OFA Port Booster Fans
6. New OFA port and reburn burner windboxes
7. New ducts, dampers, and air flow measurement
8. (24) New I-Jet oil/Orimulsion atomizers
9. Field Erection
10. Commissioning

Coleson Cove Reburn System Arrangement

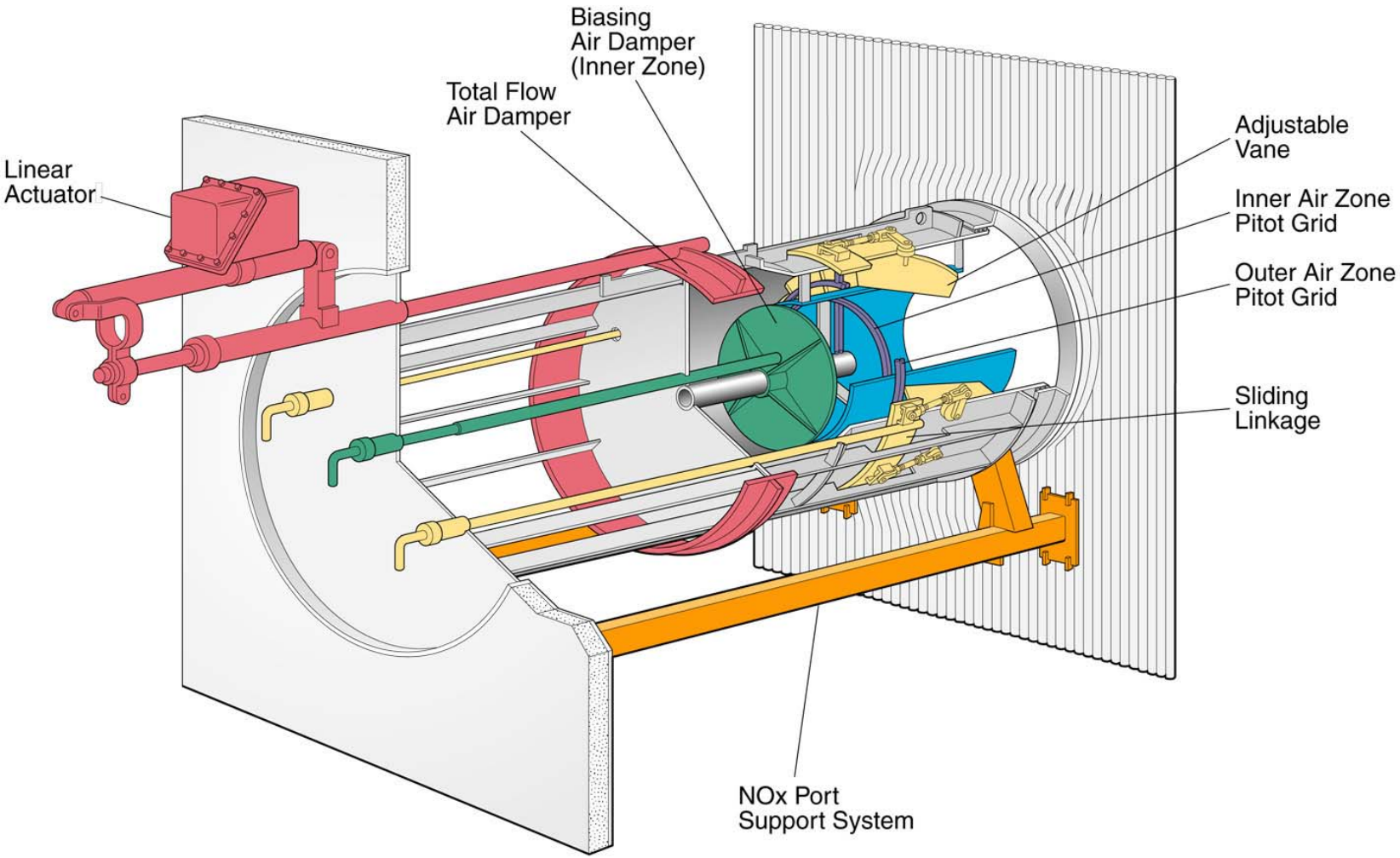


LOW NOx XCL-S™ Burner

Oil, Orimulsion, & Gas Firing

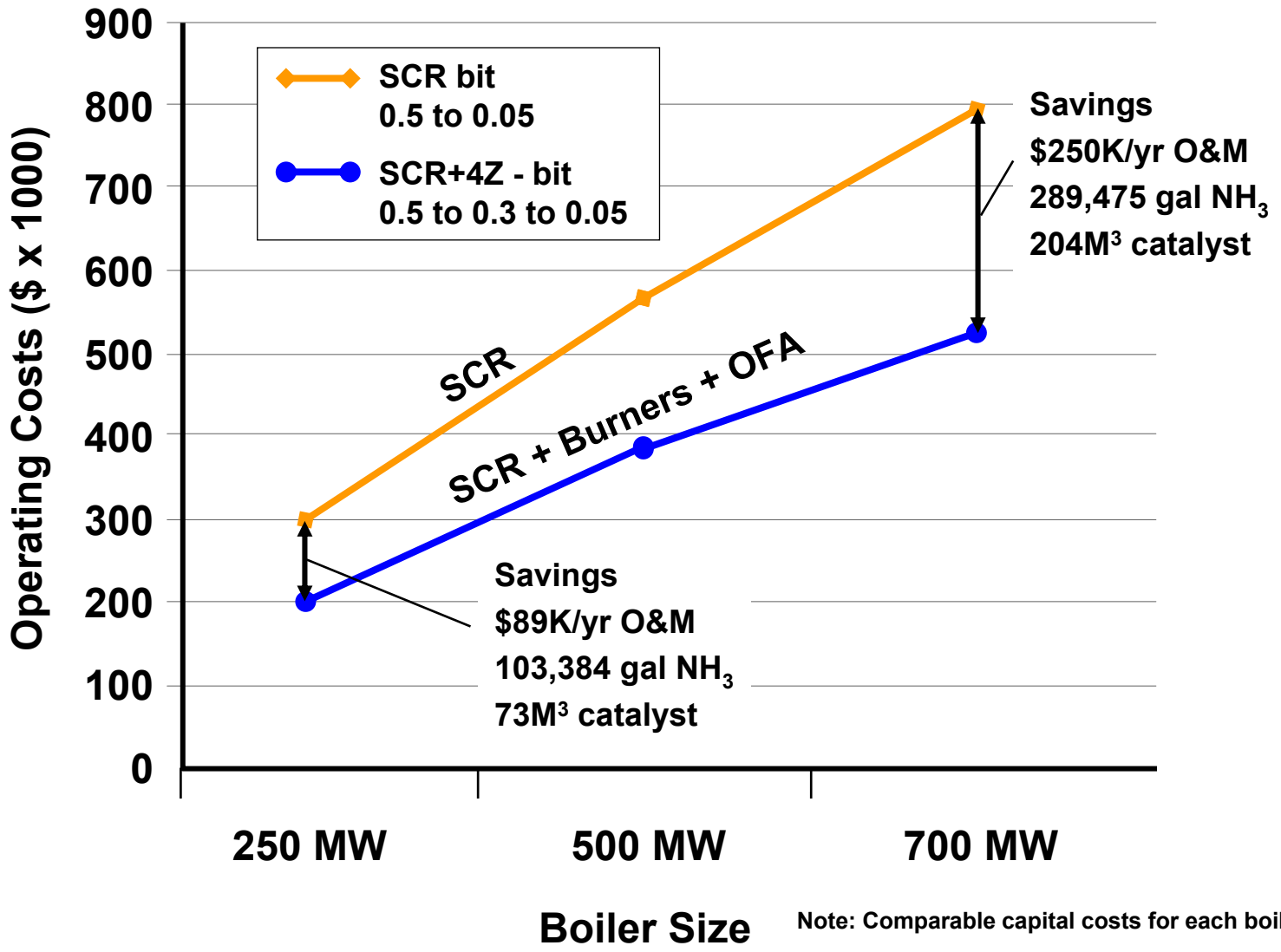


Dual Air Zone OFA Port with Total Air Flow Control



Effect of in-Furnace NOx Reduction on SCR Operating Costs

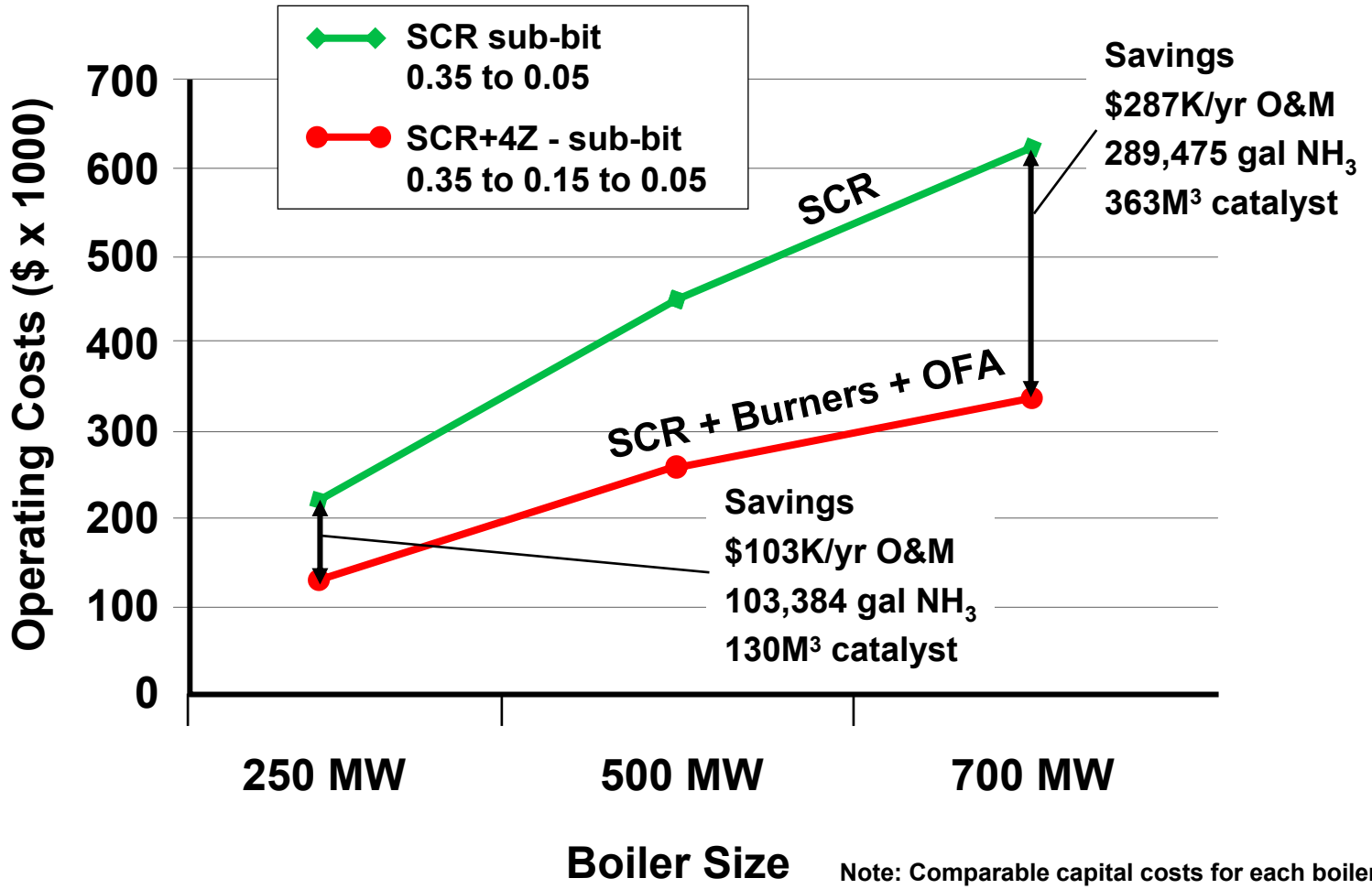
• Bituminous Coal (5 month ozone season)



Note: Comparable capital costs for each boiler size

Effect of in-Furnace NOx Reduction on SCR Operating Costs

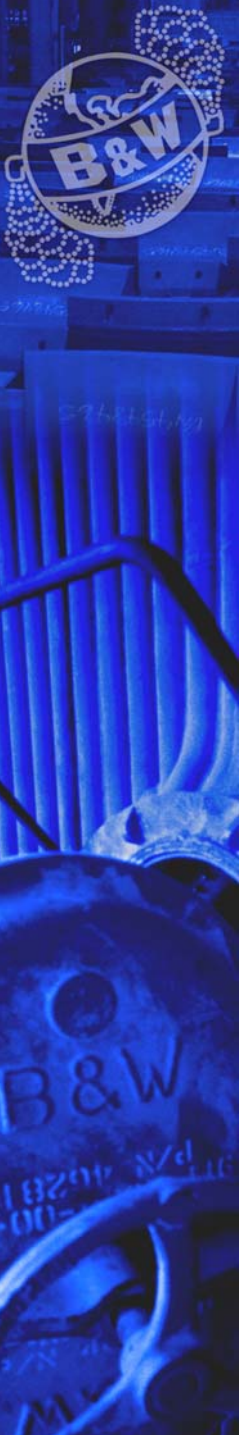
• Sub-Bituminous Coal (5 month ozone season)



Note: Comparable capital costs for each boiler size

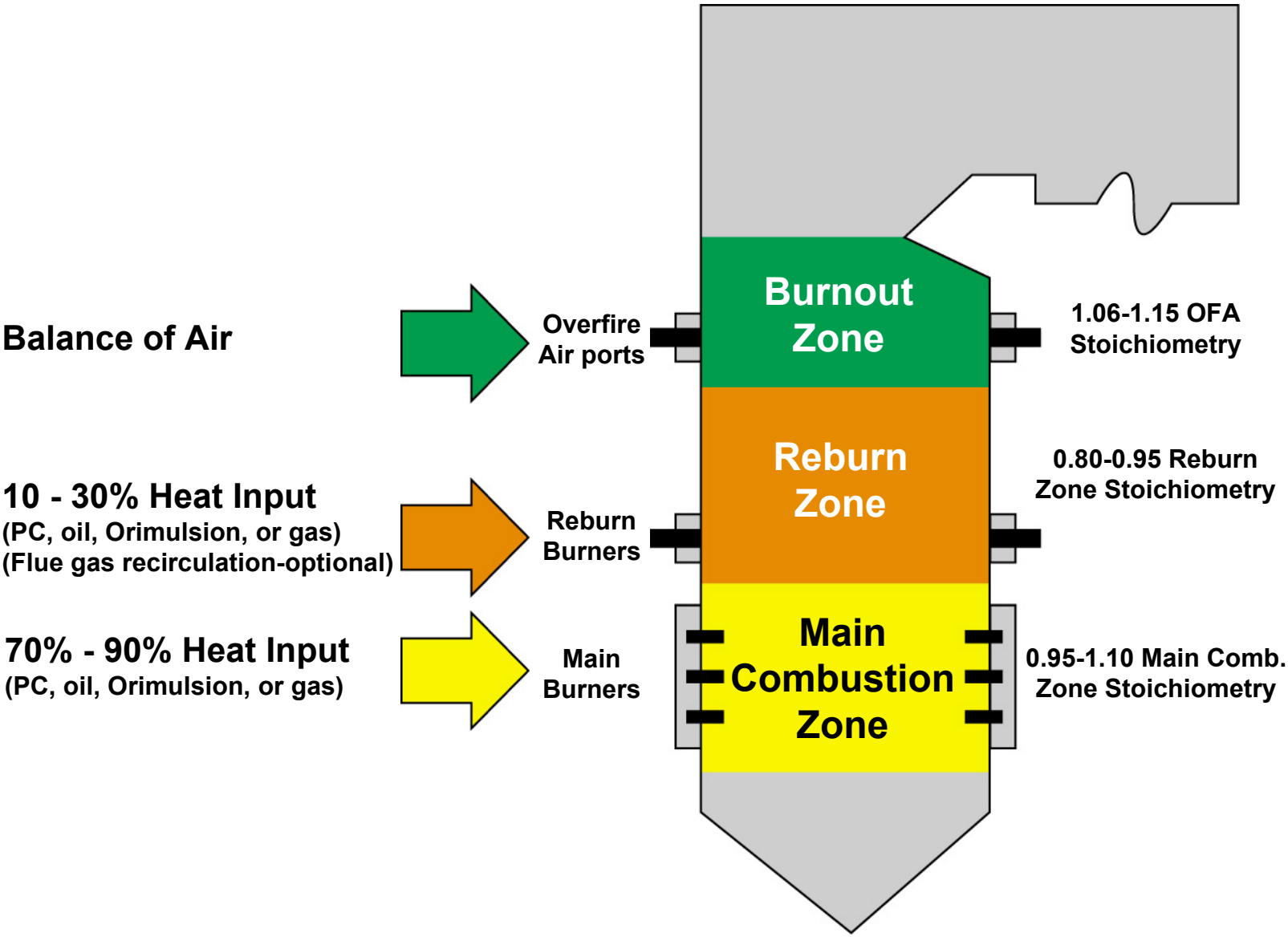
B&W and Reburning

- Reburning is part of B&W's NOx control technology offerings
- Cost and performance remain the primary consideration for NOx control technology selection
  - *$/ton NOx removed*
- Reburning appears to be competitive in some cases:
  - *High sulfur fuels*

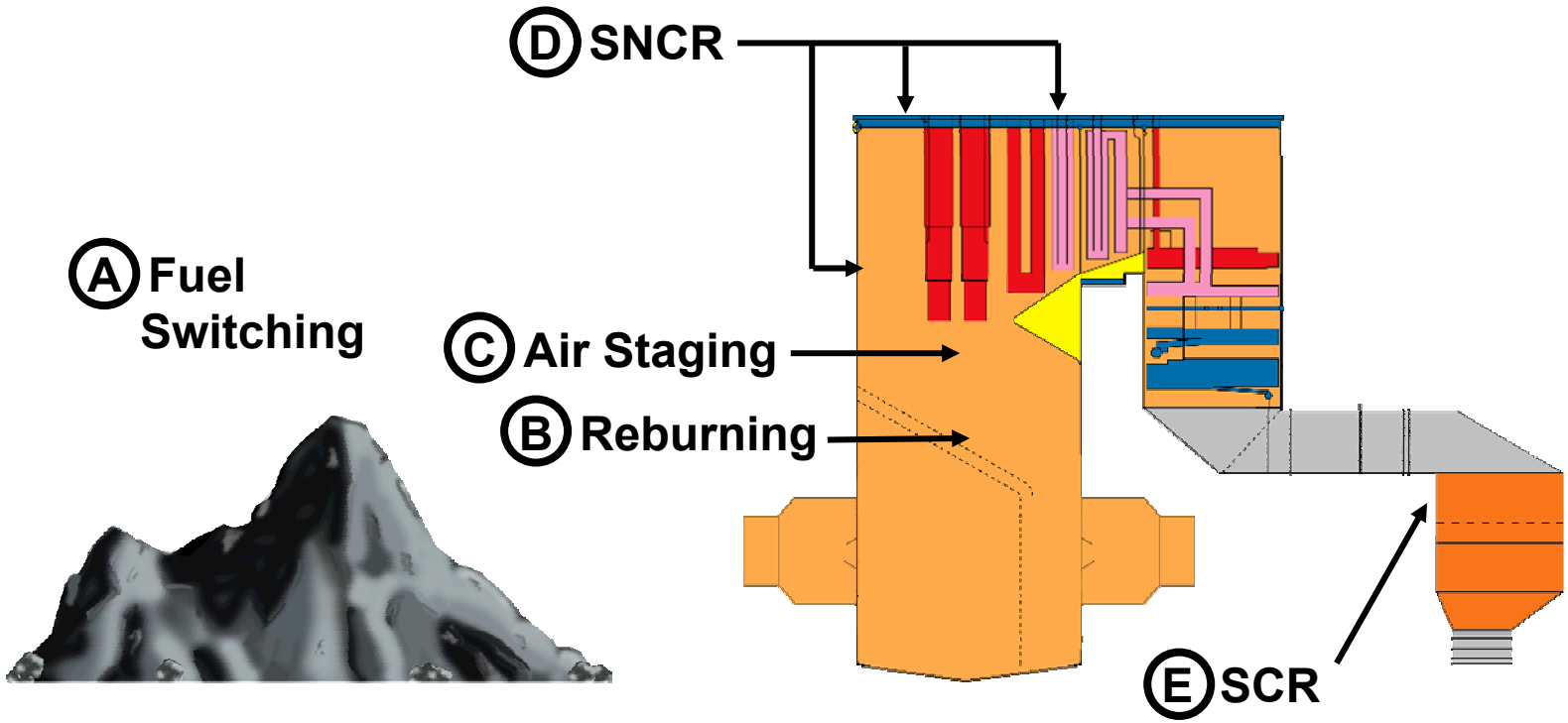


Thank You

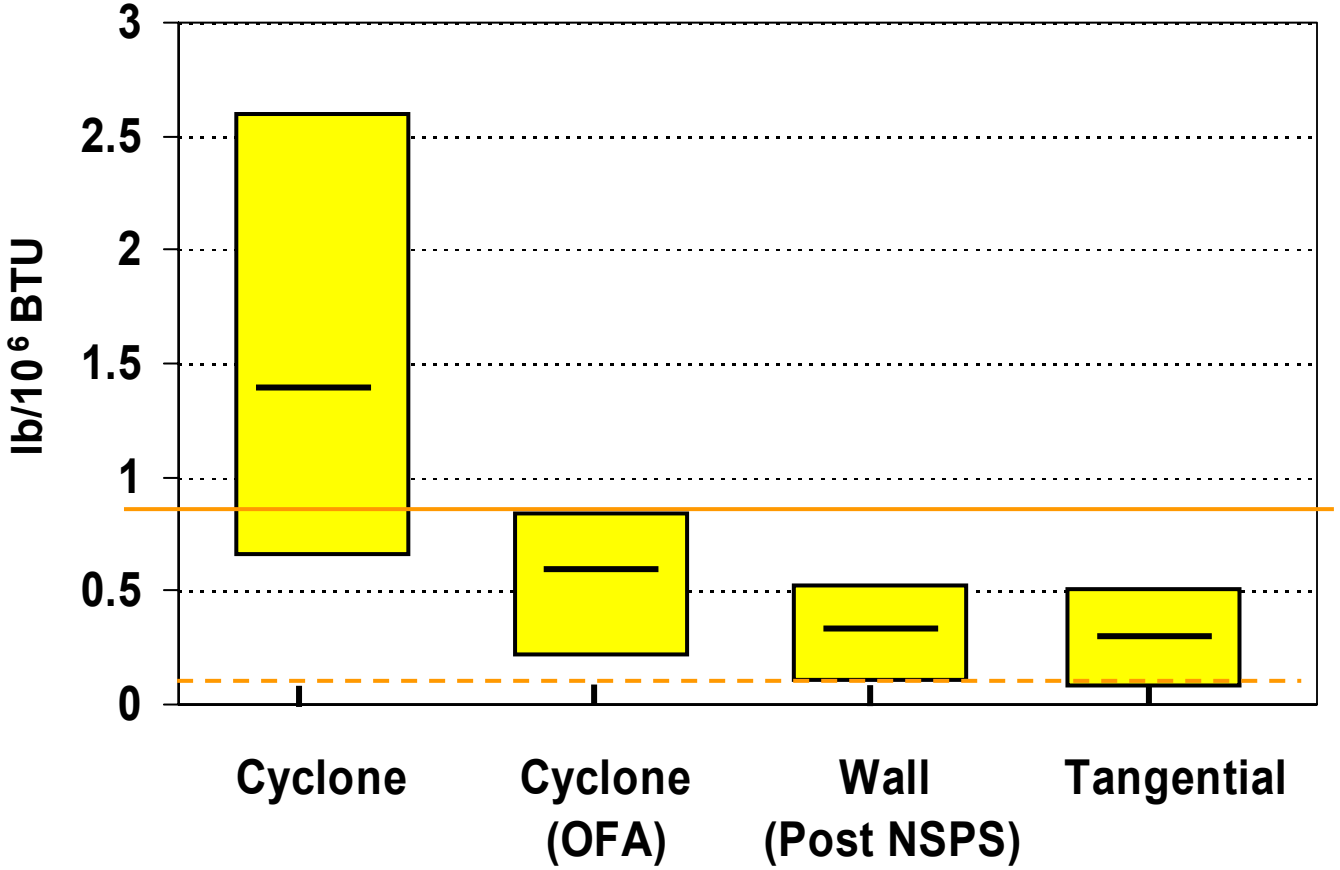
Reburning Process



Commercially Available NO_x Reduction Technologies for Cyclone Applications

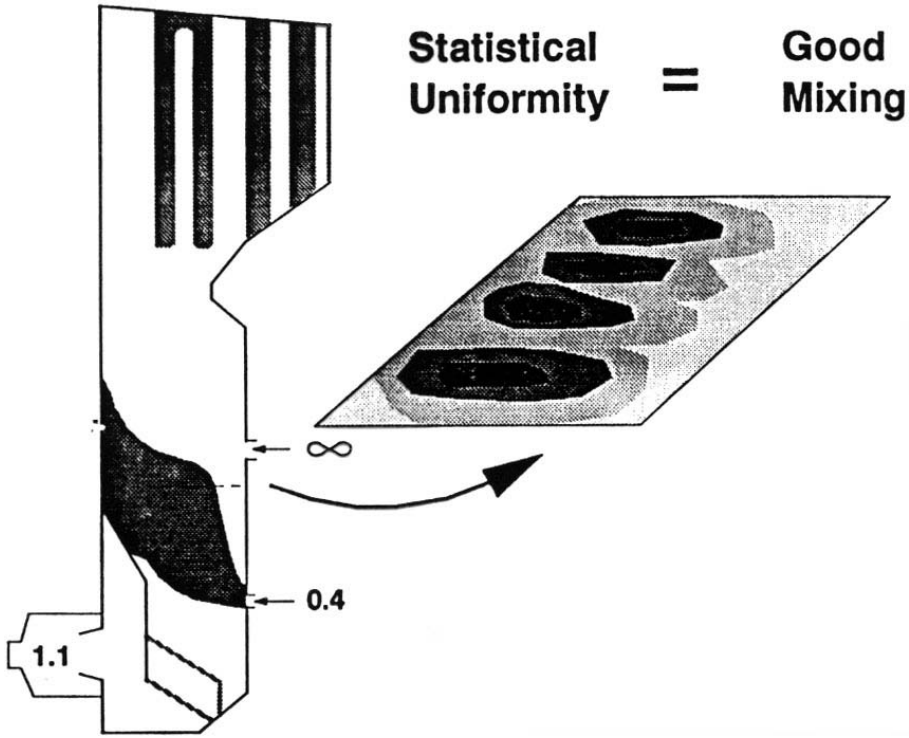


Typical NO_X Emission Levels from Various Boiler Types



How Do You Measure Mixing?

Stoichiometric Distribution



Percent Mass Flow with Stoichiometry <1

- 100% = Ideal Mixing in Reburn Zone
- 0% = Ideal Mixing in Burnout Zone

Mixing Rate